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GROWTH RESPONSE OF MAIZE TO *CROTALARIA* WEED MANURES

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Abstract

A field experiment was conducted at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad to evaluate the performance of *Crotalaria* weed manures viz. green manure (GM), compost (CM), vermicompost (VM) and dry leaf manure (DM) on the productivity and nutrient uptake of maize. For comparison, mineral fertilizers were also applied at a rate of 120, 80 and 40 kg N, P and K ha^{-1} respectively. The observations were recorded on morph-physiological traits at 101 days after sowing (DAS).On the basis of the results obtained, it is concluded that the application of compost (CM) was more effective in increasing the yield and nutrient contents of maize as compared to other treatments.

Keywords: *Crotalaria*, Green manure, Compost, Vermicompost, Dry leaf manure, Maize

Introduction

Modern agriculture with its potential to wrest country out of food trap and finds to reach the era of self sufficiency in food grain production also has brought a plethora of environmental problems. Steady or declining productivity in agriculture, impoverishment of soil fertility and degradation in water quality as a result of reckless use of chemical fertilizers. Now days, in most parts of the country, agriculture is no more sustainable due to a series of consequent complex problems [1]. Ever increasing cost of energy would be an important constraint for increased use of inorganic fertilizers in crop production, coupled with its deleterious effect on soil environment and use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in years to come for sustainable agriculture [2].

The organic materials are a scattered resource for the production of organic manures. There are various kinds of organic manures i.e. farmyard manure, green manure, compost, vermicompost etc., prepared from different agricultural or biological wastes. Organic manures increase the organic matter and organic matter in turn releases the plant nutrients in readily available forms for the crops. The nutrients of manures are highly variable from plant to plant, place to place and method of preparation [3]. Some or all of their nitrogen is changed to ammonia to nitrate and phosphorus is changed to phosphate [4].

Biologically fixed nitrogen by legumes provides a major input of available nitrogen into many soil-plant systems. The quantity of obtainable nitrogen that remains in the soil varies greatly with legume, the amount and types of legume residues left to decompose in the soil [5, 6]. Economic utilization of these natural resources through manure production can help not only in meeting the challenge of energy crises but also keeping the environment pollution free. In this investigation, attempts have been made to see the effect of leguminous weed manures on yield and nutrient uptake of maize as test crop.

Materials and Methods

Collection of weed and composting process

The fresh vegetation of *Crotalaria notonii* Wt. and Arn. was collected from the vicinity of University campus and chopped into small pieces (2 - 3 cm) by iron cutter. Equal amount of vegetation (13333 kg ha^{-1}) was used for the preparation of compost (CM), vermicompost (VM) and kept for drying as dry leaf manure (DM). The plant materials were uniformly spread in the pits for compost and vermicompost to a thickness of about 5 cm. above each layer, 5 % dung slurry and soil was added alternately, and water was sprinkled in order to keep the optimal moisture (50 - 70 %). Finally, the pits were closed with cow dung slurry and fine clay to prevent the loss of heat or exchange of gases. After partial decomposition (18 days), first turning was given for consistent decomposition and then the earthworm, *Eudrilus eugeniae* Kinberg (90 individuals per pit) were released into the vermicomposting pit. The composting and vermicomposting was completed within 17 days and absolutely decomposed good quality composts were obtained for the use in field trials.

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Experimental site, design, treatments and plot size

A field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad during Oct. 2003 - Jan. 2004. The experiment was laid out in a randomized block design (RBD) with six treatments and four replications. The fresh weed plant material as green manure (GM), compost (CM), vermicompost (VM) and dry leaf manure (DM) were applied to appropriate plots. The samples (100 gm) of each application were randomly collected in duplicate and kept in oven at 90^{o}C (48 hours) for dry weight and nutrient analysis. The results of organic amendments are reported in Table 1. These treatments were compared with 100 % fertilizers alone (FE) and control (CO). The fodder maize (*Zea mays* L.) var. 'African Tall' was sown at a rate of 100 kg ha^{-1}. A Plot consisted of nine rows spaced 30 cm apart and with the size 3 x 3 m^{2}.

Applications of fertilizers

The fertilizers N, P2O5 and K2O (120:80:40 kg ha-1) were applied through urea, single super phosphate and muriate of potash. Total amount of phosphorus (P) and potassium (K) was applied as basal dose to all the treatments except total CO at the time of sowing and nitrogen (N) was applied in two equal doses at 57 and 89 days after sowing (DAS) to FE treatment alone.

Growth analyses

The growth analyses of maize crop was recorded at 101 DAS as plant height, diameter, number of leaves per plant, plant fresh weight, 4th upper leaf length, its width and weight and leaf area per plant was determined by gravimetric method [7, 8].

Plant sampling

After harvesting of the crop, the yields were reported and samples from each plot (100 gm plot-1) were immediately collected. The samples were kept in oven 80°C till constant weight (48 h) and loss in weight was determined. The dried samples were ground and passed through a sieve (0.5 mm) to get equal size and stored in polythene bags for nutrient analyses.

Chemical analyses

Organic matter was determined by titration method [9]. Leaf chlorophyll contents (a, b and total) were estimated following Nanjareddy et al. [10]. The dry matter (DM) and calcium (Ca) content was analyzed [11]; Nitrogen (N) was estimated by micro-Kjeldahl method [12] and crude protein (CP) was then calculated as N x 6.25 [11]. Reducing sugar (RS) and phosphorus (P) was determined by colorimetric methods [13] and potassium (K) content was analyzed [14].

Statistical analysis

All the data were statistically analyzed using analysis of variance (ANOVA) test and treatment means were compared using the least significant differences (CD) at P= 0.05 [15].

Results and Discussion

Growth analyses

During growth analyses, the tallest plant was recorded with the fertilization of CM treatment followed in order by DM, VM, GM and FE amendments over the CO (Table 2). However, similar results were observed in respect of diameter, plant fresh weight and 4th upper leaf length. The width of 4th upper leaf was greater in DM amendment than in GM, CM, VM and FE applications where as its fresh weight was more with CM followed in order by DM, GM, FE and VM treatments than the total CO plots and the leaf area was maximum in the plots treated with CM amendment followed by DM, GM, VM, FE applications and minimum in untreated plots (Table 2).

Chlorophyll contents

Chlorophyll a, chlorophyll b and total chlorophyll contents varied from 0.80 - 2.00, 0.41 - 1.04 and 1.21 - 3.04 mg g^{-1} respectively (Fig. 1). The chlorophyll contents were more in all the manure based treatments than those of FE alone and absolute CO. Among these applications, chlorophyll a, b and total chlorophyll were maximum in the CM amended plots (Fig. 1).

Analyses of maize crop

The highest yield of maize crop was obtained in the plots amended with CM followed by VM, DM, GM and FE treatments over the CO (Table 3). This pattern was similar to that observed for dry matter and total reducing sugar (RS). The nitrogen (N) and crude protein (CP) contents were more in CM application than the VM, GM, FE and DM treatments and less in untreated plots. The phosphorus (P) was greater in all the organic amendments as compared to fertilized and unfertilized plots. The percent of potassium (K) was high with the sole application of FE than in GM, CM, VM and DM treatments while the calcium (Ca) was better in CM followed in order by GM, VM, DM, FE applications and lower in absolute CO (Table 3).

All the results are calculated on dry matter basis and the values are the means of four replicates. These results are statistically significant over control with the exception of diameter of plant in the FE treatment.

Based on the results, it is obvious that the combined applications of organic manure and chemical fertilizers are one of the best sources of nutrients for maize crop as reflected by increased crop growth and yield relative to the sole application of inorganic fertilizers and absolute control.

Table 1. Chemical composition of *Crotalaria* weed manures

Treatments	%						C : N ratio
	DM	Ash	N	P	K	OC	
GM	24.20	7.62	2.72	0.30	0.30	4.40	1.61
CM	70.00	86.75	0.49	0.29	0.12	2.64	5.38
VM	67.00	88.00	0.33	0.27	0.11	2.40	7.27
DM	22.91	6.25	3.28	0.38	0.32	3.60	1.09

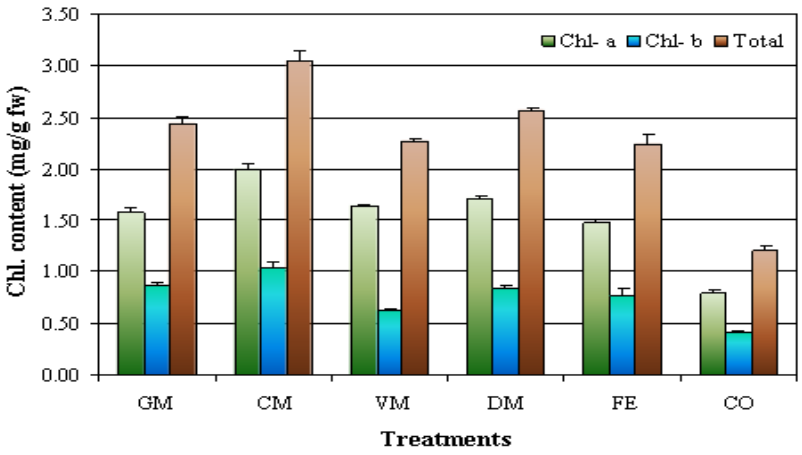
Table 2. Growth analyses of maize plant (Age of plant: 101 DAS)

Treat-ments	Plant height (cm)	Dia-meter (cm)	No. of leaves (plant^{-1})	Fresh weight (g plant^{-1})				4th upper leaf			Leaf area (cm^2 plant^{-1})
				Root	Stem	Leaves	Total	Length (cm)	Width (cm)	Weight (g)	
GM	188.07	1.34	10.50	4.30	100.17	37.37	141.84	71.62	4.12	2.90	180.00
CM	252.05	1.57	10.75	8.22	181.02	61.67	250.91	80.80	4.12	3.25	220.00
VM	200.95	1.44	10.75	4.60	129.72	51.65	185.97	75.07	3.80	2.45	177.50
DM	225.52	1.51	11.25	6.70	162.52	56.35	225.57	75.62	4.22	3.02	187.50
FE	183.37	1.10^{ns}	9.75	4.20	86.55	35.57	126.32	66.15	3.72	2.80	160.00
CO	113.97	0.95	8.25	2.12	42.07	15.35	59.54	59.52	3.17	1.60	117.50
S.E.	17.44	0.09					26.16				12.61
C.D.	39.41	0.20					59.12				28.49

Table 3. Analyses of total aerial biomass of maize crop

Treat-ments	Fresh weight		Dry matter		N		Total CP (kg ha^{-1})	Total RS		%		
	kg plot^{-1}	kg ha^{-1}	%	Kg- ha^{-1}	%	kg -ha^{-1}		%	kg ha^{-1}	P	K	Ca
GM	29.750	33055	12.00	3965	1.35	53.87	336.71	6.00	237.58	0.07	0.83	0.82
CM	31.500	35000	12.15	4254	1.38	59.72	373.27	6.22	264.69	0.06	0.73	0.84
VM	30.500	33888	11.90	4061	1.30	54.84	342.74	6.10	247.88	0.07	0.67	0.81
DM	30.225	33583	12.07	4038	1.11	45.26	282.90	6.00	242.54	0.06	0.67	0.72
FE	27.750	30832	11.87	3665	1.24	45.57	284.81	5.63	207.25	0.05	0.98	0.64
CO	10.700	11888	12.52	1472	0.82	12.10	75.65	4.50	66.31	0.04	0.48	0.47
S.E.	2.96	3293		390		6.39	40.00		27.32			
C.D.	6.69	7442		882		14.44	90.40		61.74			

Fig. 1. Leaf chlorophyll contents of maize in response to *C. notonii* weed manures at 101 DAS (n = 4 ± SE).



Conclusion

From the above results, the present study indicate that the application of compost treatment (CM) along with mineral fertilizers has far more noticeable effect on the nutrient uptake and yield of maize crop than that of all other amendments. The present results are in close conformity with the findings of Naklang and Rojanakusol [16].

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